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ABSTRACT

This booklet is designed to provide basic information about creeksheds in urbanizing areas; why they are important, how they are adversely affected by urbanization and what can be done to protect creek benefits and avoid problems. The text provides non-technical information relating to small watersheds and their management. The booklet is designed as a source book for those with an interest in but no experience with water resource problems. A glossary of related terms and a bibliography are included for reference. (CS)

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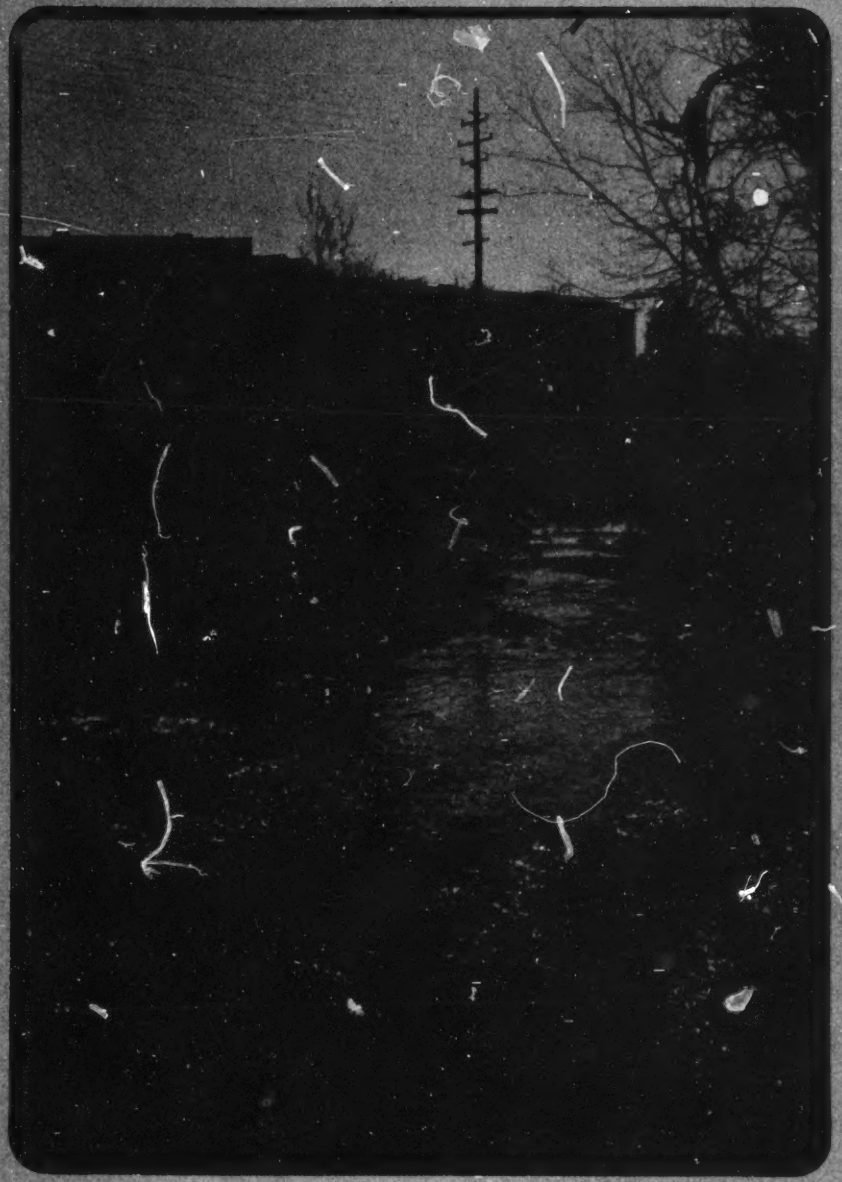

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PROTECTING CREEKSHEDS

analysis and action

SE 023 921

THE HURON RIVER WATERSHED COUNCIL

The Council is an organization of local units of government formed to encourage and assist the wise and orderly use of the Huron River as a natural resource. It was organized in 1965 under Michigan Public Act 253 of 1964, the "Local River Management Act," which enables townships, cities, villages and counties to undertake cooperative water resources planning and management activities. Ongoing Council programs involve studies and research on the water resources of the watershed, advising and cooperating with Federal, State and local agencies on water resources management issues and providing informational and educational services.

The 125 mile long Huron River is a tributary of Lake Erie and drains 900 square miles in Southeastern Michigan. The watershed is on the western boundary of the Detroit Metropolitan region. The quantity and quality of the River is greatly influenced by the many creeks which flow to the Huron.

Huron River Watershed Council
415 West Washington Street
Ann Arbor, Michigan 48103

OFFICE OF WATER RESEARCH AND TECHNOLOGY

The Office of Water Research and Technology is a Federal government agency concerned with defining and supporting high priority water resources research. It was created by Congress in 1964 (the Water Resources Research Act, P.L. 88-379) to undertake a cooperative water resources research and training program. Title I of the Act provides for the support of Water Resources Research Institutes at the Land Grant Colleges in the fifty states and Puerto Rico. These Institutes support a program of research and manpower training in all areas of the water resources fields. Title II of the Act provides for grants and contracts to public or private agencies in selected water resources research areas. The CREEKSHEDS project is a Title II project.

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Washington, D.C. 20240

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THE CREEKSHEDS PROJECT

This booklet is one result of a research and development project conducted by the Huron River Watershed Council for and with the assistance of the Office of Water Research and Technology, U.S. Department of the Interior. It draws on experience gained during that project and on other publications developed for communities in the Huron River Watershed.

The project explored methods and techniques of managing the natural sub-units of a river's watershed: Its CREEKSHEDS. It involved the study of the varying effects of different land uses on creeks or streams in an urbanizing region. Particular emphasis was placed upon developing special management programs tailored to local conditions and points of view.

ABOUT THIS BOOKLET. . .

Creeksheds are significant but often overlooked elements in the local natural environment. Important functions are performed and benefits provided by creeksheds when their natural systems remain intact. In areas where urbanization has occured, these systems often have been disrupted resulting in lost benefits and the need for costly public construction projects.

This booklet has been written to provide basic information about creeksheds for those in urbanizing areas; why they are important, how they are adversely affected by urbanization and what can be done to protect creek benefits and avoid problems.

The booklet presents only the most essential information relating to small watersheds and their management. It is intended as a non-technical publication for those with an interest in protecting creeks but without experience in water resource problems.

It is hoped that the booklet will serve as a source book for information and as a guide for action. The experience on which it is based is from the Great Lakes region and from Southeast Michigan in particular. However, the conditions, issues, and problems found in many other parts of the country are very similar. The management approaches suggested here for creekshed protection and improvement will therefore have many applications elsewhere.

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PROTECTING CREEKSHEDS

analysis and action

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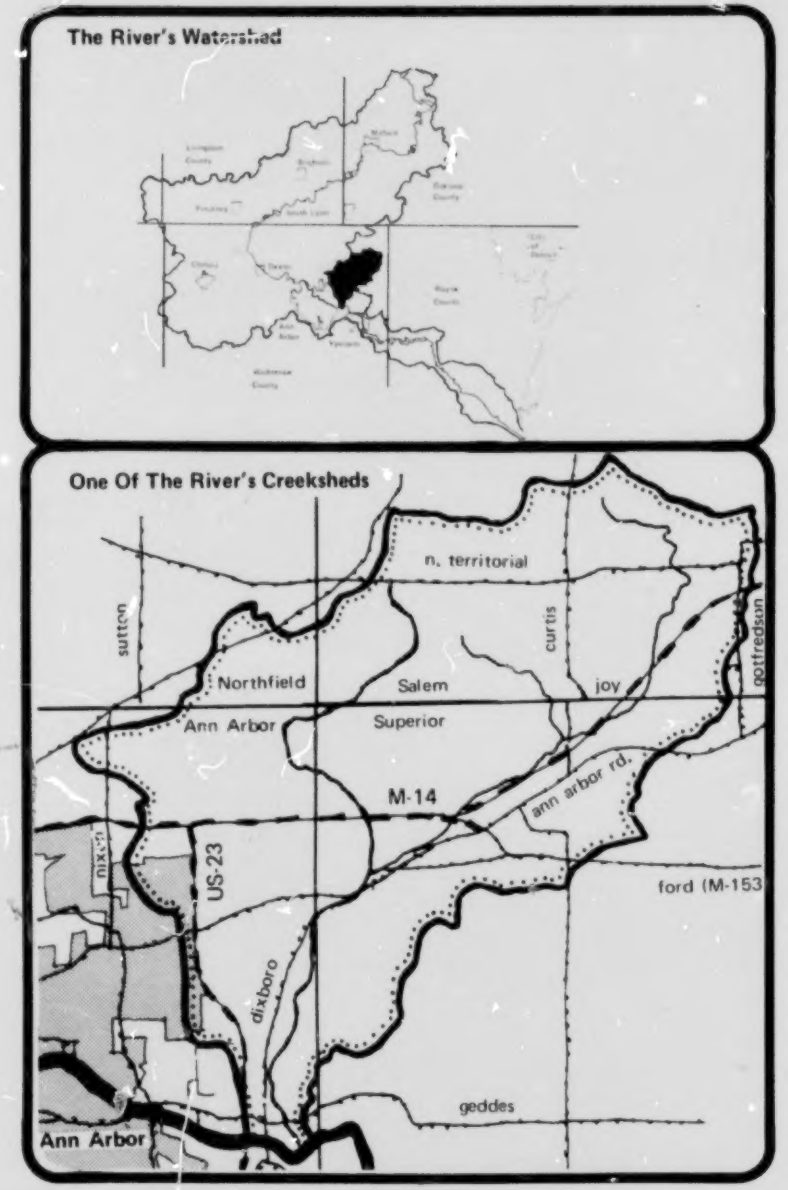
WHAT IS A CREEKSHED?

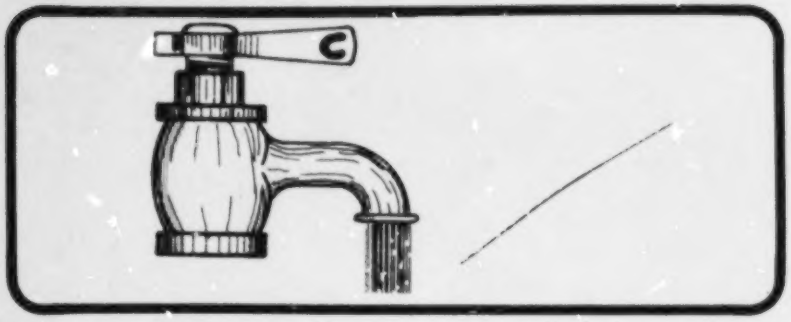
A creekshed is the watershed or drainage basin of a creek. It is a natural land and water unit consisting of a stream and all the land that drains into that stream. Creeksheds have a wide variety of physical characteristics. They may be very large in area or only a few square miles. Their topography may vary from nearly flat to rugged and steeply sloping. There may be great differences in types of land use, soils, vegetation, and slope of the creek bed all of which can greatly influence the water of the creek.

The term "creekshed" is not one that will be found in textbooks or in research literature. It has been coined to draw attention to the special importance of small, natural, environmental units to those who live in the communities closest to them. A creekshed whose natural systems are intact provides a variety of benefits for the communities within its boundaries. But creeksheds also are the sub-units of a watershed. They are the building blocks of the river system and as such provide a direct local contribution to regional water quality. Thus actions within the land area of a creekshed which adversely affect the creek will very likely have an ultimate adverse impact on the river.



WHY BE CONCERNED?: BENEFITS A CREEK CAN PROVIDE

Water Supply



The waters of the creek are used in many areas for domestic and agricultural purposes, we swim in them, irrigate from them, and they supply water for livestock or other farm animals.

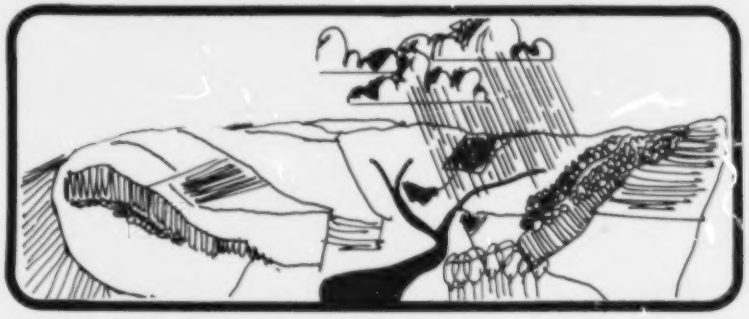
Amenity

Creeks and their adjacent lands are a distinctive signature on the landscape. They offer a natural contrast to the character of the human-built environment. Vegetation encloses or divides the landscape providing visual variety.

Recreation

The creek serves as an informal neighborhood or community recreation resource. One may walk along its banks, fish in it, hunt along it, observe or study nature along it, photograph it, or simply enjoy viewing it.

Drainage



A creek serves as a collector of stormwater and as a means of conveying that water into another, larger watercourse. During heavy rains or spring floods, a creek channel and its flood plain, if free from development, can accommodate significant increases in water flow. Development in the creekshed must be carefully evaluated for its effect on drainage.

Wildlife

Many forms of wildlife depend upon the creek for food, shelter, breeding habitat, or water supply. There are distinctive forms of wildlife which are associated with the stream itself, the wetlands in the creekshed and with the upland areas. Many species of birds, fish, and mammals are found in the creekshed.

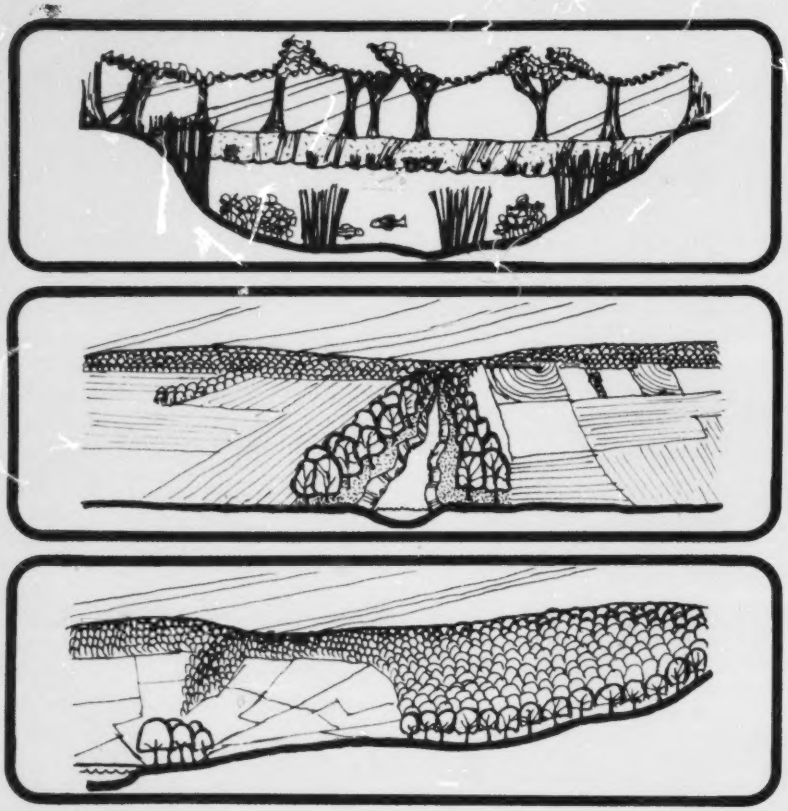
Open Space

Creek corridors are an important link in an open space system. Their presence enables one to "read" the landscape. If the land near a creek corridor is sensitively developed, the creek can provide a sense of green space. Visual access is often all that is required to achieve this "open" effect.

A CREEKSHED ENVIRONMENT

In order to better understand how creeksheds are changed it is important to know about the natural systems and natural resource base of such an environment. The "parts" of the creekshed, the water cycle (or how water moves through a creekshed), and the relationship of the creek to the river into which it flows are presented on this and the next page.

Components



The Creek Bed

The creek bed is the water channel, the banks of the creek, and the plant and animal life associated with the creek bed. The vegetation immediately along the creek banks is also included in this component. The creek bed is the most fragile and easily damaged component in the creekshed. The land use changes in other parts of the creekshed, in many cases, will cause drastic changes in all aspects of the creekbed: water quality, water quantity, channel shape, bank stability.

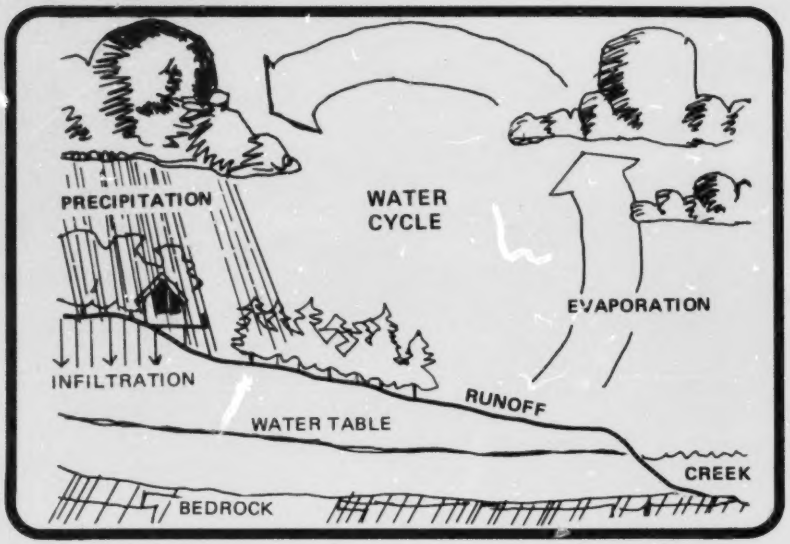
Creek Corridor

The creek corridor is a strip of land of variable width on either side of the creek bed. It contains singly or in combination those sensitive areas which if altered could seriously degrade the creek. The corridor is made up of the following elements when they are directly associated with the creek channel: vegetation along the channel, wetlands, slopes over 12% and soils whose physical characteristics make them inappropriate for development.

Upland

The balance of the land in the creekshed is upland, proportionally the largest component in a creekshed. The way in which this land is managed or used will influence the quality, quantity, and timing of storm water runoff from the upland which in turn will greatly influence the magnitude of problems in the creek corridor or creek bed. Depending on the region of the country the upland could be quite rolling, rather flat, quite steep or some combination of these.

Water Cycle



The water cycle ties together living and non-living things in a creekshed. It is called a water cycle because water moves between (and over or through) the land and the atmosphere and back again to the land. Most of the water falling as rain or snow does not reach the creek at all. Much rain or snowfall evaporates almost immediately back into the atmosphere or is absorbed by vegetation. The water remaining on the earth can reach the creek in two ways: 1) by running off the surface of the land directly into the creek or, 2) by soaking into the soil and becoming part of the groundwater which may feed the creek through underground seepage. The water cycle can be severely altered by land use change associated with the urbanization process which reduces the water holding capability of the soil or creates impermeable surfaces. A more detailed account of the changes appears on pages 11–12.

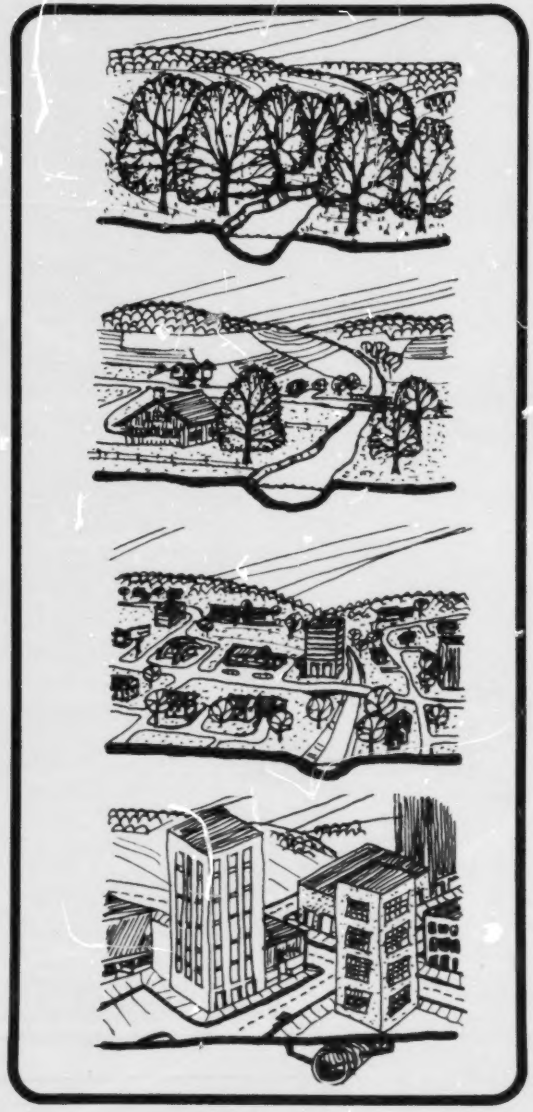
Creek-River Relationships

Creeks ultimately flow into other, usually larger, bodies of water. The drainage area of the creeks or tributary streams flowing into a river make up the river's watershed: creeksheds are the subunits, or building blocks, of a river's watershed. What happens to the land area of a creekshed will greatly influence the quality and quantity of the creek's water and in turn greatly affect the river into which it flows. Every property owner or land manager (individual or corporation) in a creekshed can directly or indirectly influence the creek and in turn the larger system of which the creek is a part. If wisely managed the creek will provide important environmental, economic, and social benefits to the local communities in its immediate proximity and in addition the creek will protect or improve the quality of the river.

URBANIZATION: SOURCE OF CHANGES

Urbanization is the change in land use from generally extensive, open uses (such as forestry and agriculture) to more intensive uses (residential, commercial and industrial uses). Urbanization is caused by population growth and movement within a region or state. The demand for housing, transportation, commercial space and community services will alter the way land is used and cause many modifications in the landscape. The chart below indicates the major actions associated with or stimulated by urbanization and the impacts such actions may have on local water resources. The illustrations at right depict some of the visual changes in a creek as urbanization progresses.

Change in Land Use	Possible Effect on Water Resources
Early Urbanization	
Removal of trees or vegetation	Decrease in transpiration (water vapor given off by vegetation)
Scattered city-type residences	Increase in stormflow of creek
Limited water and sewage facilities	Increased sedimentation in streams
Construction of septic tanks and sanitary drains	Possible contamination of nearby wells or streams from overloaded sanitary drain system
Middle Urbanization	
Bulldozing land for mass housing, top-soil removal	Accelerated land erosion and stream sedimentation, increased flood flows
Mass construction of houses, paving streets, building curbs and gutters, driveways, parking lots, street drains, filling of wetlands	Decrease infiltration, resulting in increased flood flows, lowered ground water levels, overtopping or undermining of banks, lowered water quality
Untreated or inadequately treated sewage discharged in streams	Pollution of streams, inferior quality water available for downstream water supply and recreation
Late Urbanization	
Additional houses, streets and public, commercial, industrial uses	Reduced infiltration and lowered water table, high flood flows and lower base flows
Channels of creeks changed to artificial channels or tunnels (building in flood plain)	Increased flood damages and flooding downstream
Enclosing creek for all or part of its length	Increased flooding and flood damages, health concerns due to water back up, lowered water quality in river



An Urbanized Creekshed

The land use changes and their consequences for water resources as shown on the preceding page combine to produce a special set of conditions in an urbanized creekshed. The chart on page 7 indicates how creek benefits can be degraded as the land area of the creekshed is built up. Many social and/or economic gains may be realized as this urbanization occurs. The problem is that these gains are not balanced against all of their costs. Creek benefits as a result are often lost forever even though large sums of money may be ultimately spent to deal with the impacts of development upon the creekshed.

IMPERVIOUS SURFACE

A major portion of the land surface has been made impervious through intensive use of the land. Rooftops, sidewalks, driveways, curbs and gutters, roads and parking lots replace the soil and natural ground cover. As a result there is little infiltration of water into the ground below the hard surfaces. Most of the precipitation runs off directly through downspouts connected to storm drains or over the land and into gutters and storm sewers.

UNDERGROUND STORM DRAIN

To accommodate the increased runoff a drainage system physically separate from the original creek has been constructed below the ground to collect and transport storm water to the river. Most downspouts from houses and buildings are connected to the storm drain. So too are parking lots and gutters.

CREEK GONE

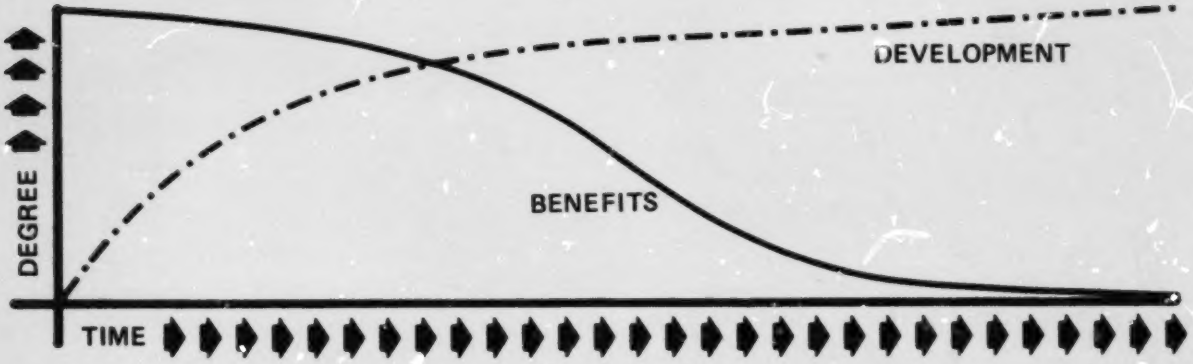
The creek itself has ceased to exist as a natural unit on the surface of the land. The flow of water has been removed from its channel on the surface of the land and placed in a concrete pipe buried below ground.

FLOOD PLAIN DEVELOPMENT

Development has occurred in the original creek bed and on the land immediately adjacent to the creek. These flood plain locations are still subject to flooding during periods of high water even though normally there may be no indication of the potential danger.

LOWERED WATER QUALITY

The concentration of people and uses in the urbanized area has also concentrated the amount of dirt, debris and organic matter that finds its way into the storm drainage system. Such pollutants severely reduce the quality of water in the "creek". The lowered water quality restricts the use of the river for water supply by downstream communities, reduces the range of recreational opportunity available to community residents, degrades essential aspects of the wildlife habitat associated with the river and impairs the river's visual appeal.


DEVELOPMENT
BENEFITS
DEGREE
TIME

BENEFITS
WATER SUPPLY
RECREATION
WILDLIFE
AMENITY
OPEN SPACE
DRAINAGE
RECREATION
AMENITY
OPEN SPACE
DRAINAGE
DRAINAGE
TIME

COST
$
$
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$
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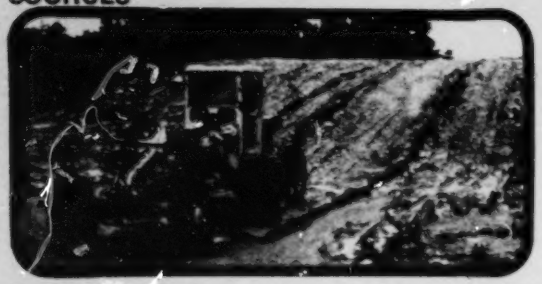
TIME

PROBLEMS CAUSED BY URBANIZATION

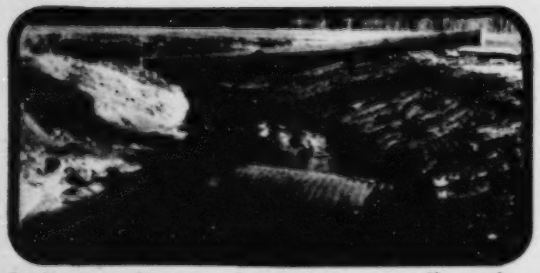
SOIL EROSION/SEDIMENTATION

SOURCES



Erosion and sedimentation are almost hidden problems. Soil may be washed off at construction sites, from slopes without vegetative cover, from cropland, exposed streambanks, and road construction sites.

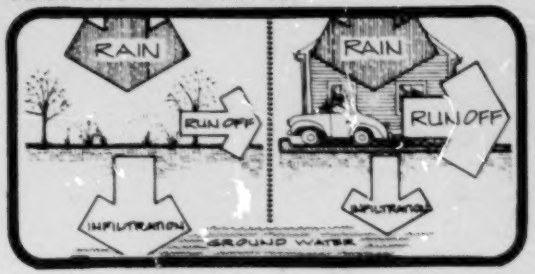
EFFECTS



Sedimentation can lower water quality, clog drainage ways, contribute to flooding, destroy wildlife and their habitat (particularly fish), reduce visual and amenity values of the creek and necessitate costly dredging or removal.

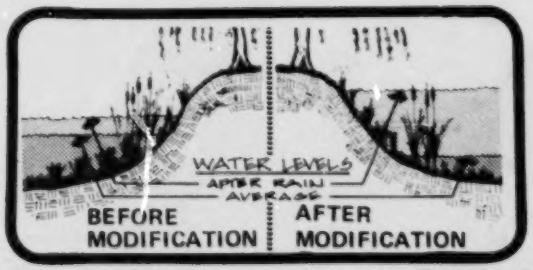
CHANGE IN RUNOFF CHARACTERISTICS

SOURCES OF CHANGE



Runoff characteristics are those which influence how fast and in what quantity water running off the land gets to a creek. Changes to the creekshed land surface which increase the impervious surface (for example, rooftops, parking lots, streets) will change the runoff characteristics.

EFFECTS



As proportionally more water runs off the land surface than infiltrates the soil many consequences may occur: the rate and amount of erosion may increase, flooding downstream will occur more often, wildlife habitat will be destroyed, the flow of the creek will fluctuate greatly.

WATER QUALITY

SOURCES

What happens on or to the land influences the quality of the water in the creek. The sources of lowered water quality include the organic and inorganic material washed off of streets and roads and non-point material from agricultural operations (sediment, organic matter and nutrients).

EFFECTS

Poor water quality reduces the usability of the water and creek environment and is likely to harm the water course into which the creek flows. Many uses may be affected by poor water quality: local recreation, wildlife, amenity, water supply.

Actions in Sensitive Areas

The general problems referred to on page 10 occur as a result of specific actions. On this and the following page the four most sensitive areas of the creekshed environment are shown along with the consequences of certain actions which may occur within each area.

sensitive soils

ACTIONS	IMPACTS
Clearing/Grading	• erosion and sedimentation; increased run-off • loss of water storage capability
Filling /Compaction	• alters soil composition and moisture content—results in change of vegetative cover • reduces infiltration and thus water table levels • increases run-off • likely downstream sedimentation and flooding
Roofing/Paving	• erosion and sedimentation • increased run-off • may alter natural surface drainage • lost water storage capability • if storm water run-off water is contaminated, water quality is lowered
Liquid Waste Disposal	• soil may not percolate or support bacteria necessary to assimilate organic waste—results in ponding, odors, contamination of surface and ground waters, general health hazard • if transported to water course, it may increase biological production
Fertilizer/Pesticide Application	• potential for surface run-off into creeks (on impervious soils) • may accumulate in soil changing nutrient characteristics and altering surface vegetation • see this block on the "wetlands" page
Plowing /Cultivation	• possible soil erosion causes sedimentation down stream • turbidity produced by sedimentation causes lowered water quality and may affect fish habitat

corridor vegetation

ACTIONS	IMPACTS
Clearing/Grading	• destroys natural vegetative cover and wildlife habitat • may alter surface drainage patterns • loss of amenity • exposes soil to erosive forces
Filling /Compaction	• destroys natural vegetative cover and thus wildlife habitat • fill material or soil in compacted state may not support original plant species • change in underground drainage patterns effecting surface vegetation in the area
Roofing/Paving	• destroys natural vegetative cover and wildlife habitat • increases run-off; thus quantity of water in creek • reduces infiltration and the level of the water table • altered surface drainage patterns
Liquid Waste Disposal	• potential health hazard if chemical contaminants are not first removed • may be incompatible with plant species disrupting growth patterns or destroying valuable species • could act as a fertilizer in water • excessive disposal could plug soil causing standing surface water
Fertilizer/Pesticide Application	• pesticides could cause harm to life forms in the food chain of the primary consumers of the vegetation • application may end up on vegetation other than that intended • may accumulate in soil or pollute ground or surface water resources
Plowing /Cultivation	• destroys vegetative cover and wildlife habitat • exposes soil to erosive forces • possible loss of valuable top soil necessary to support vegetative cover

steep slopes [≥12%]

ACTIONS	IMPACTS
Clearing/Grading	• loss of wildlife habitat • change in drainage patterns • erosion of exposed surfaces and sedimentation on land or in water—flooding, lowered water quality, visually unattractive • remaining slope may collapse later if not stabilized
Filling /Compaction	• same as above plus change in infiltration rates
Roofing/Paving	• during construction, same as "clearing/grading" • increased run-off • potential for direct run-off into creeks
Liquid Waste Disposal	NOT APPLICABLE
Fertilizer/Pesticide Application	• potential for direct run-off into creeks • increased biological production (algae, weed growth, undesirable animals) when run-off reaches water • vegetation removed may increase chance of erosion, bank collapse
Plowing /Cultivation	• soil erosion causes sedimentation in stream—loss of fish habitat, reduced flow in stream • decreased water quality due to turbidity • visual quality lowered

wetlands

ACTIONS	IMPACTS
Clearing/Grading	• loss of wetland function (water storage, ground water recharge) • loss of wildlife habitat (shelter, food supply) • lost water filtering capability • likely downstream sedimentation and flooding
Filling /Compaction	• see "clearing/grading" above • surface water flow blocked (possible higher water levels upstream) • local groundwater table may be lowered • increased runoff and higher peak water levels downstream
Roofing/Paving	• "hard" surface increases runoff-higher peak water levels downstream • lost water storage capability • vegetation and wildlife habitat destroyed • less water infiltrating soil lowers ground water table • contaminated storm water runoff lowers water quality • bank and creek bed erosion due to increased flows
Liquid Waste Disposal	• nutrients increase biological production (algae or weed growth, unwanted animal species) • coliform bacteria may cause public health hazard • drinking water supplies may be impaired • loss of local recreational use • visual quality is lowered
Fertilizer/Pesticide Application	• nutrient overloads increase biological production (algae, weeds, unwanted animal species) • flow of creek reduced by overgrown vegetation • chemical poisons destroy plants and animals, contaminate water resources • pesticides resist decomposition and build up
Plowing /Cultivation	• soil erosion causes sedimentation in stream-loss of fish habitat, flow in channel restricted, water level during high flow increased • visual appeal lowered • decreased water quality due to turbidity

STRATEGIES

Goals of Action

Action by individuals, businesses or communities is undertaken to achieve certain predetermined objectives. The following goals are suggested as realistic objectives for the recommended actions beginning on page 15.

To protect existing benefits provided by the creeks.

To prevent the future pollution of creeks in urbanizing areas.

To save individuals and communities the great expense of correcting problem situations which can be avoided.

To transfer the costs of protecting the creek benefits to those responsible for the causes of environmental change.

To maintain a flexible, open-minded approach to dealing with creek related decisions.

Environmental Concepts

Basic environmental concepts should be recognized and incorporated into whatever actions are taken to protect or improve a creekshed. (The general statements below are translated into Creekshed Management Principles on the following page.)

The environment is made up of bio-geo-chemical cycles which are linked together and interrelated.

The flow and amount of essential nutrients (phosphates and nitrates) determine life processes. Nutrients are cycled between living and non-living, between plants and animals and between water and land systems.

Actions in or on one part of the environment may be felt in some other part of the environment.

Where major water and land systems come together there is a much greater diversity of species and higher productivity than exists in either alone. Such areas are called ecotones or "edges". The creek corridor is such an edge.

The greater the number of species in an environment the more stable will be that environment.

Creekshed Management Principles

1. Deal with *all* of the creekshed drainage area. In a physical sense most if not all of the sources of change come from within the creekshed.
2. The relationship between land uses and water resources must be examined. Changes in the land surface of a creekshed can affect the local surface water resources, that is, creeks.
3. Changes in the upland component of a creekshed will influence the creek corridor and creekbed. These changes may occur slowly in a piecemeal fashion over a long period of time.
4. Changes in the upper portion of the creekshed will influence the environment and benefits provided in the lower or downstream sections of the creekshed.
5. The physical characteristics of the water in the creekshed are of great importance. Water quality will influence the number and kinds of plants and animals to be found in the corridor. Water quality also affects the amenity and recreation potential of a creek.
6. The greatest pollution of the creek occurs while the creekshed is being intensively urbanized. In most cases the impacts on a creek are proportional to the level of development in the creekshed and the proximity of development to the creek corridor.
7. When a creekshed is in more than one local political jurisdiction cooperation and coordination is essential to attain effective management.

Key Concerns in Creekshed Management

1. REGULATE CHANGES IN CHARACTERISTICS INFLUENCING RUNOFF

Where does the runoff go?

How much of it is there?

What is the chemical and physical nature of the runoff?

What effect will the runoff have on the creek corridor and creek bed?

2. PROTECT THE CREEK CORRIDOR

The water course

Vegetation along banks

Steep slopes

Soils limited for development

Wetlands

3. CONTROL SOIL EROSION AND SEDIMENTATION

ACTION: LOCAL GOVERNMENT

General purpose local units of government should become involved in creek management because creeks on the whole have a large impact on community welfare and because local units of government have an implicit responsibility to protect the public trust in such resources. The following approaches might be considered:

1. USE EXISTING PROCEDURES AND INSTITUTIONS TO PROTECT CREEKSHED BENEFITS

In general the power to protect the health, safety, and welfare of the community can be used to influence how the creek is modified. Creek protection measures can be incorporated into the following local government activities:

- Planning and development decisions about where public services are located.
- The development review process. Proposed development usually must meet certain standards in order to be approved by a local planning commission. The Commission can establish criteria which will enable it to control changes in runoff characteristics. The Commission may require developers to submit information which is relevant such as: soil erosion and sedimentation control plans, amount of impervious surface, vegetation removal, manner of handling water runoff, etc.
- Conditional use procedures. Designation of certain kinds of development within the creek corridor as a conditional use allows the local governmental unit to maintain continuing control on activities in these areas.
- Building codes. If water resource considerations are incorporated here storm water runoff and septic tank-drain field construction can be regulated on a site-by-site basis to protect creek benefits and avoid problems.

2. WORK WITH LOCAL AGENCIES EMPOWERED TO CONDUCT DRAINAGE PROJECTS

Several states have created local agencies to organize, finance, and administer drainage projects. Such agencies can have a tremendous influence on the condition of creeks and they should be identified and contacted. In Michigan, the state where this project was done, the County Drain Commissioner fulfills this function and this individual can do small watershed planning and management. Property owners or units of government can petition the Drain Commissioner's office to perform desired projects.

3. REQUIRE PERFORMANCE BONDS

Land use change in the creek corridor especially should be undertaken only after a performance bond has been posted. Such a bond can be used by the local unit of government to pay for the restoration of a creek; for example, if pollution is allowed to occur or if the builder or contractor fails to provide effective measures to prevent soil erosion.

4. REINFORCE STATE LAWS WHICH RELATE TO CREEK PROTECTION

This can be done through adopting policies, ordinances and administrative procedures. There are usually many state laws which indirectly bear on creek protection. They may fall into one of the following categories: soil erosion/sedimentation control, inland lakes and streams protection, drainage law, wetlands protection, natural rivers protection, water quality protection, water pollution abatement. Your State Representative should be able to provide complete information about legislation in your state that relates to these areas. The state agency administering each Act could be of assistance in relating state law to protecting the local environment.

5. INVESTIGATE CREEK PROTECTION THROUGH PUBLIC OWNERSHIP

Many states permit local units of government to acquire complete title or easements in land for public purposes. Preventing downstream property from flood damage or preventing water pollution could be such public purposes. In addition to purchase of the full (fee) title of the creek corridor other techniques include preferential tax assessment, scenic or development easements (many states have "Open Space Preservation" legislation) and transfer of development rights.

ACTION: PROPERTY OWNERS

Land use practices on private property can greatly affect a creek. The following suggestions are easily accomplished by property owners (individuals or corporations). These suggestions should be considered by those owning land along a water course AND by those owning land in the upland. These actions refer to general creek corridor protection and water quality matters as well as to soil erosion and sedimentation control. Some apply to land being used for agricultural operations. Referring back to pages 11 and 12 may be helpful after reading this page.

1. PROPERTY MANAGEMENT

- Do not fertilize lawns down to the water's edge.
- A strip of vegetation should be left as a buffer between the creek and residences. This keeps the water cool (helping to preserve coldwater fish species), prevents erosion, provides wildlife habitat and maintains the character of the creek.
- Stream crossings by livestock or horses should be avoided.
- Marshland or any kind of wetland should be left in its natural state and off limits to cattle.
- If the land next to the corridor is cropland, inorganic fertilizer should be applied in the right form at the right time; organic fertilizers should be applied when there is no danger of their being washed into the creek.
- Erosion sites anywhere on the property should be eliminated (by planting vegetation, sodding and filling, rerouting flow, building a splash apron, using barriers to slow down velocity, etc.).
- Septic tank drainfield systems should be checked every two or three years to be certain they are operating properly. The septic tank may have to be pumped out periodically in order for it to provide proper treatment.

2. PROPERTY DEVELOPMENT CONSIDERATIONS

These suggestions will maintain or enhance the value of your property and protect the creek.

- Do not disturb the creek corridor if at all possible.
- Learn about the soils of the site and the physical limitations associated with those soils.
- Implement a soil erosion control program for the site.
- If there will be more runoff water as a result of changing the use of the site, handle it by infiltration or storage and slow release.
- Be certain that the soils are adequate to accommodate a septic tank-drain field system.

3. WHERE TO GO FOR HELP

- Most counties have a Soil Conservation Service representative who can explain the nature of your soil and its best uses. Soil Conservation Districts in your county may also have an active soil conservation program which could provide information about crop and woodland management.
- Other assistance may be available from the Cooperative Extension Service, the county or state Health Department, the county drainage engineer, or the state wildlife biologists.

ACTION: CITIZENS

Local public agencies need to know what their constituents want; they need to have public input. Local policy boards need such information in order to be responsive and also to have the political support to make difficult decisions. There is a necessary role for the citizen to play when it comes to protecting creeks and the benefits they can provide. In many cases the difference between a high quality, beautiful creek and one which has become a polluted eyesore is the vigilance and concern of citizens and citizen groups. The following suggestions are essential steps in establishing a process of meaningful citizen participation.

1. DEVELOP A FACTUAL BASE OF INFORMATION

- Understand the rules of the game by which the changes that affect creeks are undertaken: know about local ordinances relating to planning and development, state legislation and, in general, the decision-making process involved in land use change.
- Survey and document the condition of the creek. Develop as much information as you can about the creek's environment. Studies or reports which may have been done by public agencies or private consultants can be helpful.
- Get to know the staff of the local, regional, state and Federal agencies which may be involved. They should be able to provide technical information and tell you which legislation applies.

2. ANALYZE THE PROBLEM AND COMMUNICATE THE PROBLEM

- Define the problem.
- What benefits are being affected?
- Who or what is responsible for the immediate problem?
- With the facts in hand let your local officials know your concerns.
- State pollution control agencies should also be contacted to determine if a violation of state water quality standards has occurred.

3. MAINTAIN A LONG RANGE PERSPECTIVE TO INSURE CONTINUING CREEK PROTECTION

- It is always preferable to prevent a problem rather than wrestle with it after it exists. The informed, active citizen or citizen group should be involved in creek protection while there is still a creek to protect.

- Cultivate a good working relationship with officials at all appropriate levels:

LOCAL LEVEL

- Local units of government have many options available. See page 15.
- Local government planning commission – These groups adopt development policies and usually a zoning map with a desired land use pattern. Water resource protection is usually not fully integrated in such efforts but could be.
- Agencies responsible for drainage – The policies, operating standards and enabling legislation of these agencies can be quite important. See the note under point 2 on page 15.

REGIONAL LEVEL

In most metropolitan areas there is a regional planning commission or a council of governments with a professional staff. These organizations have expertise in many areas (e.g., health, criminal justice, transportation, housing) including environmental and water resource issues. They also are sources of information and can be helpful in identifying and addressing local water resource problems. Watershed associations or councils exist in many states to promote sound water resource management, study river basin and water related problems and assist in coordinating actions of governmental units. In Michigan, watershed councils can be organized under the Local River Management Act (P.A. 253 of 1964); other states often have similar enabling legislation.

STATE LEVEL

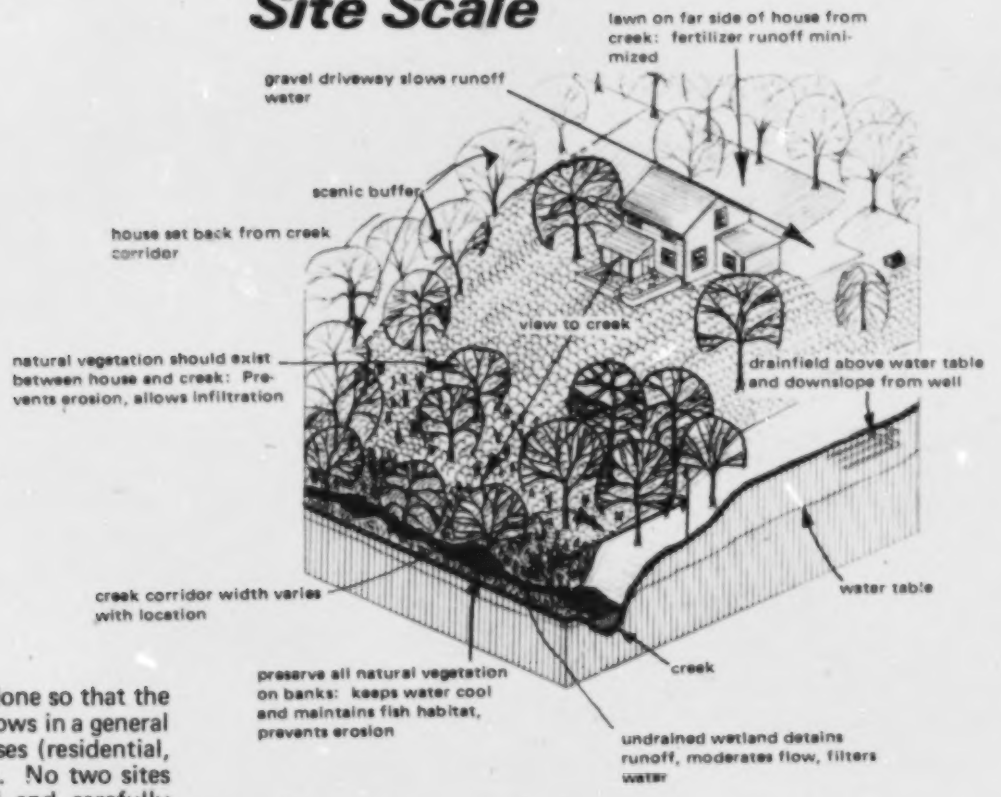
State governments are involved because of state legislation dealing with environmental protection, natural resource use or management and State water quality standards. The administration of such legislation is a state government activity.

FEDERAL LEVEL

The most useful piece of legislation today (1974) with respect to encouraging citizen participation in water resources is based on the Federal Water Pollution Control Act Amendments of 1972. This act requires the states to permit public (citizen) review and comment on proposed pollution discharge permits. Investigate this legislation with your state water pollution control agency or the Regional office of the U.S. Environmental Protection Agency.

DESIGN SUGGESTIONS

Site Scale

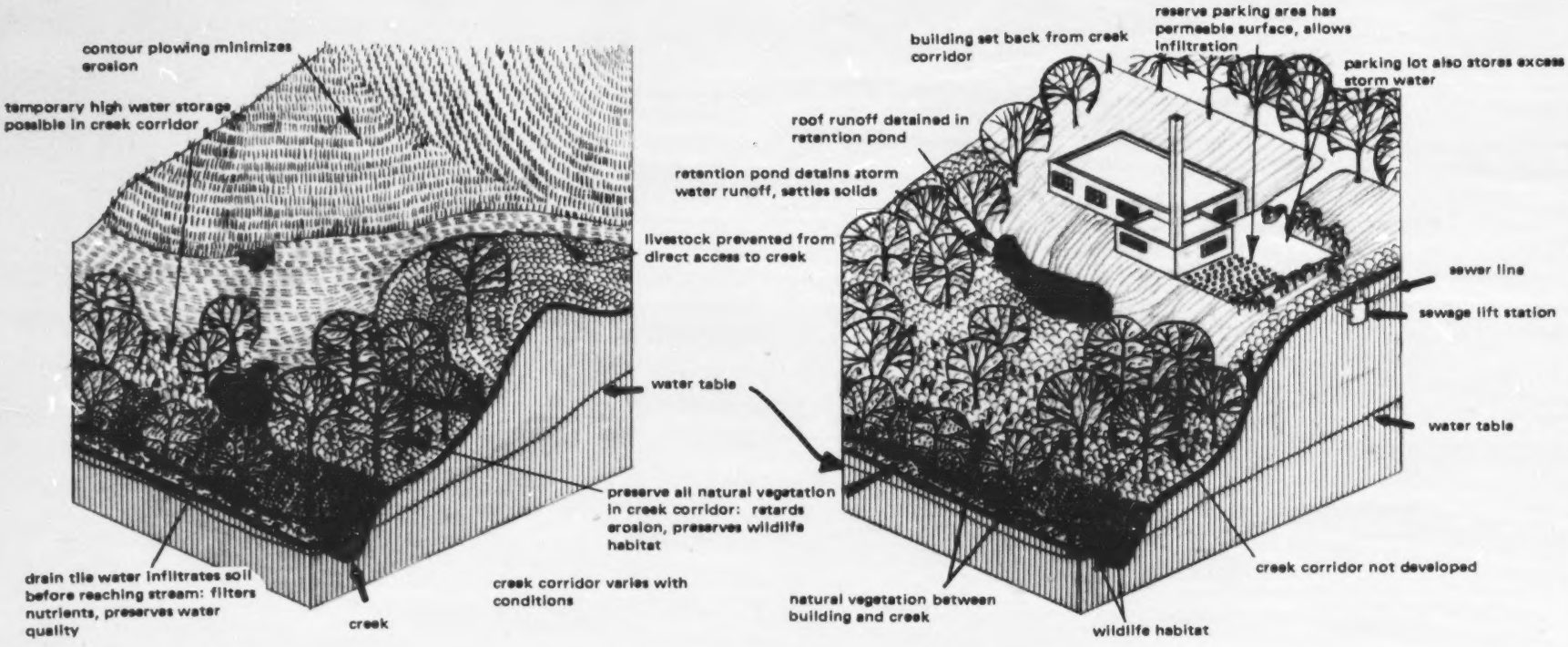

lawn on far side of house from creek: fertilizer runoff minimized
gravel driveway slows runoff water
scenic buffer
house set back from creek corridor
view to creek
natural vegetation should exist between house and creek: Prevents erosion, allows infiltration
drainfield above water table and downslope from well
creek corridor width varies with location
water table
creek
preserve all natural vegetation on banks: keeps water cool and maintains fish habitat, prevents erosion
undrained wetland detains runoff, moderates flow, filters water

When land is developed in a creekshed it *can* be done so that the benefits of the creek are protected. This section shows in a general way what should be considered when different uses (residential, commercial and agricultural) are placed on a site. No two sites are alike, of course, so each must be analyzed and carefully planned. The sketches may not look like any creek landscape you know; they should be useful though because they highlight development techniques which respect the creek's values and sensitive features.

Design considerations for sound creekshed management at three different scales: the site, the project and the creekshed are presented here. It is important to realize that very large projects can have very large adverse impacts on a small watercourse. At this scale too, care must be taken that the physical developments undertaken by the public sector will serve to protect creek benefits and avoid future problems.

RESIDENTIAL USE

The first consideration in the site planning process should be whether *any* development is appropriate especially if the parcel is in a creek corridor. If the site has no serious physical limitations (soils, vegetation, steep slopes, wetlands for example) the development should not lower or ruin the quality of the creek related site. (At this scale the physical design of the site should include the following considerations: vegetation buffers along banks and between dwellings, runoff water stored or infiltrated on site, adequate sewage treatment which does not pollute the creek or ground water.


contour plowing minimizes erosion
temporary high water storage possible in creek corridor
livestock prevented from direct access to creek
water table
preserve all natural vegetation in creek corridor: retards erosion, preserves wildlife habitat
drain tile water infiltrates soil before reaching stream: filters nutrients, preserves water quality
creek
creek corridor varies with conditions
building set back from creek corridor
reserve parking area has permeable surface, allows infiltration
parking lot also stores excess storm water
roof runoff detained in retention pond
retention pond detains storm water runoff, settles solids
sewer line
sewage lift station
water table
creek corridor not developed
natural vegetation between building and creek
wildlife habitat

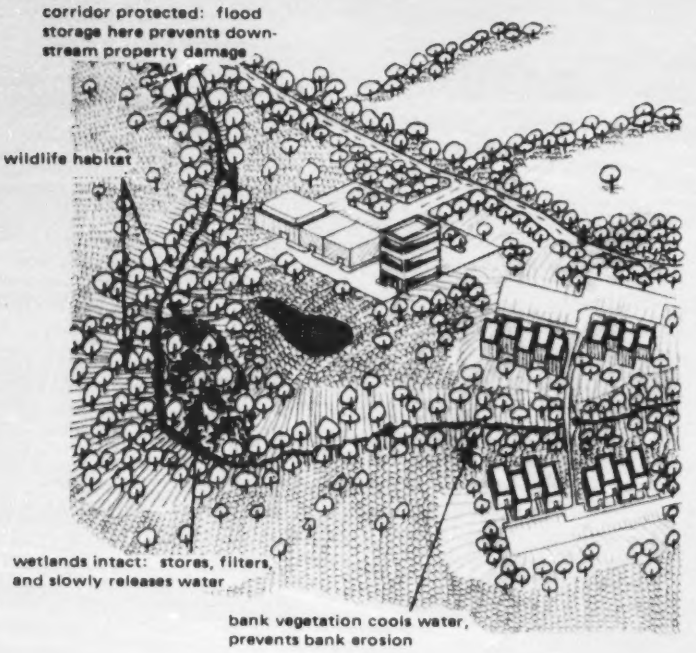
AGRICULTURAL USE

In many areas land along a creek is being used for agricultural purposes. This kind of use can also affect the creek's quality both in the immediate area and downstream. The illustration above notes some of the land and water conservation practices which are appropriate for this land use. Some of these considerations have to do with physical changes: draintile which dissipates the water before it gets to the creek, contour plowing, preservation of a vegetated buffer strip along the creek corridor, fence lines along the creek corridor if the land is grazed. Other considerations have to do with treatment of the land: when and what kind of fertilizers are applied to fields, and what kind of crop (row crop or ground-covering crop) is grown near the creek.

INDUSTRIAL/COMMERCIAL USES

These uses can generate many adverse impacts on the creek at the point where they occur as well as downstream. Such uses often have large parking areas or roof surface areas. They may require a large volume of water for manufacturing products. This suggests a need for careful analysis of: wastewater disposal methods (domestic sewage or process water), quantity of runoff generated from buildings or parking lots, setback from creek corridor to preserve scenic or natural quality, and amount, kind and placement of vegetation elsewhere on the site.

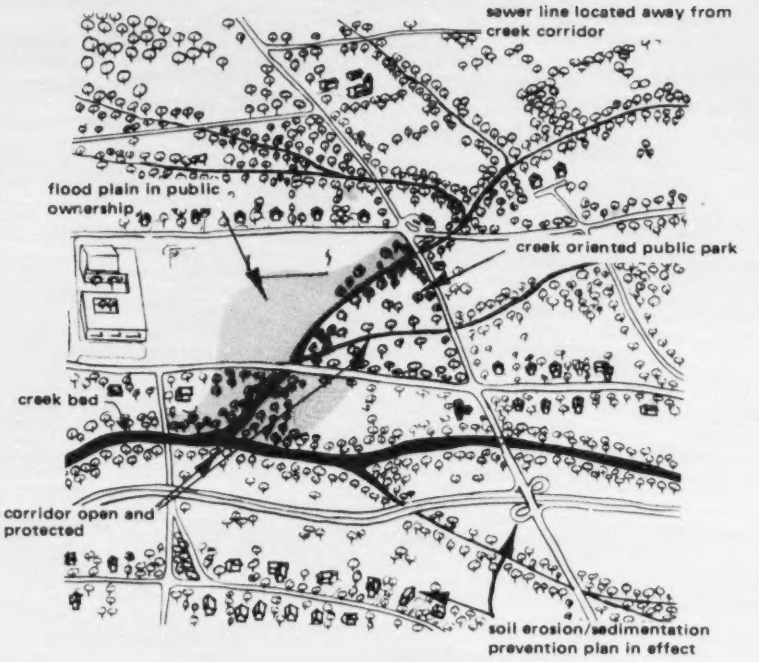
Large Project Scale


corridor protected: flood storage here prevents down-stream property damage
wildlife habitat
wetlands intact: stores, filters, and slowly releases water
bank vegetation cools water, prevents bank erosion

THE LARGE PROJECT SCALE

At this scale of development a much larger parcel of property is being planned or developed. Even if such a development is some distance from a creek it can still greatly affect a creek and down-stream property. The following should be provided for: minimal change in the runoff rate, preservation of the hydrological function of the natural creek bed, non-degradation of land and water quality of the creek corridor during and after construction, maximum scenic enhancement and maintenance of wildlife habitat.

Creekshed Scale


sewer line located away from creek corridor
flood plain in public ownership
creek oriented public park
creek bed
corridor open and protected
soil erosion/sedimentation prevention plan in effect

THE CREEKSHED SCALE

This scale is the entire creekshed. "Good" design or "wise" land use at this scale depends upon the implementation of the measures already mentioned for the site and project plus some assurance that expenditures for public services will not result in degradation of creek benefits. At this scale the benefit realized is a smoothly functioning, high quality creek system. The units of government and communities in the creekshed can enjoy many or all of the creek's benefits (drainage, wildlife, amenity, water supply, open space and local recreation). In addition, significant savings can be realized by *not* having to pay for pollution abatement or control, or installation and maintenance of drainage "improvements". Flooding will be minimized and private property values will be stablized or increased.

ADDITIONAL INFORMATION

Glossary

CREEK BED
The channel of the creek which carries water most or all of the time. This area supports many forms of plant and animal life.

CREEK CORRIDOR
The most sensitive component of the creekshed, consists of stream channel, vegetation on stream banks, soils with severe limitation for development, steep slopes (over 12%) and wetlands. Modification of these areas can produce severe adverse changes in the creek environment.

CREEKSHED
A land and water unit made up of a creek and its drainage area. A building block of the larger watershed.

EASEMENT
A specified right of use which one party may have or purchase with respect to a parcel of land owned by another. Easements may be "positive" allowing the holder of the easement to use the land for certain purposes (e.g., right of way for a utility line) or "negative" prohibiting the land owner from using his land in specified ways (e.g., intensifying its use when development rights easement is held).

ENVIRONMENT
All of the things, conditions and influences which affect an organism or a community.

EROSION
The wearing down or washing away of the soil and land surface by water, wind or ice.

FLOOD PLAIN
Land adjacent to lakes, creeks and rivers which is covered as water levels rise and overflow the normal water channels.

FLOOD PLAIN MANAGEMENT
A variety of methods used to protect property and lives from flood damage or hazards. Such management can include zoning to limit development of the flood plain, watershed land use controls, selective land acquisition, flood insurance, and flood proofing of existing dwellings or structures subject to inundation.

GROUND WATER
Underground water in a zone of soil saturated with water.

HABITAT
The place where a plant or animal lives, which has all of the conditions necessary to support its life and reproduction.

MANAGEMENT PLAN
A blueprint or plan for action in accomplishing a given objective. A management plan for a creekshed would involve an assessment of the conditions of the resources (land and water), land uses, the objectives to be accomplished (usually protecting a benefit or eliminating a problem such as erosion) and the means for achieving the objectives.

PEAK FLOW
The greatest volume of water passing or expected to pass by a given location on a water course. It is influenced by amount of precipitation, soil moisture, permeability of the soil and ground cover and size and slope of the drainage area.

PLATTING
The process of recording the subdividing of land into small lots or parcels.

POLLUTION
Any alteration in the character or quality of the environment which renders it unfit or less suited for certain uses.

RUNOFF
Water moving over a sloping land surface, usually towards a water course.

RUNOFF CHARACTERISTICS
The features of the landscape in a creekshed environment which determine how much runoff will occur, where and when. Key features are amount and kind of vegetation and natural ground cover, amount of impervious surface (roads, parking lots, rooftops, etc.), slope and soil types (particularly their infiltration capability).

SEDIMENT
Solid material both mineral and organic, which has been eroded from its site and deposited elsewhere, usually in the channels of a river or creek.

TRANSFER OF DEVELOPMENT RIGHTS
A method of protecting historic, scenic or otherwise unique but relatively low economic value resources from destruction by development. The owner of the resource can sell, exchange or receive credit for the difference in value of his property in its undeveloped condition as opposed to its value when put to its "highest" use.

UPLAND
The largest component of a creekshed composed of the land area which is at a higher elevation than the creek bed and creek corridor. Modifications of runoff characteristics in the upland can greatly alter the other two components (creek corridor and creek bed).

URBANIZING CREEKSHED
A creekshed which is experiencing a rapid rate of change in its land uses from extensive, open uses (agriculture, for example) to intensive uses (subdivisions, industrial, commercial space).

WATERSHED
A drainage area or basin; all land and water areas which drain or flow toward a central collector, such as a stream, river or a lake at a lower elevation.

WATER TABLE
The upper surface of ground water; the point below the surface of the earth where the soil is saturated with water.

WATER QUALITY
A way of describing the relative purity of water based on the dissolved or suspended matter in it. Such matter will determine how it can be used and the kind of wildlife species which can survive in it.

WETLANDS
A vital part of a creekshed environment. Such areas filter flowing water, absorb spring flood waters and slowly release water. Wetlands are also important wildlife habitat for many aquatic and terrestrial species.

ZONING
Laws enacted by local units of government to regulate land uses and development. Zoning is the process of dividing the local government jurisdiction into a number of districts (or zones) where only specified uses may take place. Used to implement and enforce plans to protect public health and welfare and to attain the "best use" of available land. Zoning can protect creek corridor areas from overdevelopment and improper uses or to prevent pollution to protect the benefits provided by the creek.

Publications

BOOKS

Challenge of the Land, Charles E. Little, Open Space Action Institute. $3.75 paperback.

The Use of Land, A Citizen's Policy Guide to Urban Growth, William K. Reilly, ed. Thomas Y. Crowell Company. $3.95 paperback.

Design with Nature, Ian L. McHarg, Doubleday/Natural History Press. $5.95 paperback.

Living With Your Land. A Guide to Conservation for the City's Fringe, John Vosburgh, Charles Scribner's Sons. $2.65 paperback.

A Practical Guide to Water Quality Studies of Streams, F. W. Kittrell, U.S. Department of the Interior, Federal Water Pollution Control Administration. $0.70.

Hydrology, C. O. Wisler and E. F. Brater, John Wiley and Sons. $11.95.

Ecology, Eugene P. Odum, Harcourt, Row and Webster. $4.25 paperback.

A Sand County Almanac, Aldo Leopold, Sierra Club/Ballantine. $0.95 paperback.

The Last Landscape, William H. Whyte, Doubleday. $2.50 paperback.

Defending the Environment: A Strategy for Citizen Action, Joseph L. Sax, Random House. $1.95 paperback.

Streams, Lakes, Ponds, Robert L. Coker, Harper Torch Books. $2.25 paperback.

Pamphlets

"Manual of Septic Tank Practice." Public Health Service Bulletin 526. USGPO, Washington, D.C. $0.50.

"Water Facts and Figures for Planners and Managers," Geological Survey Circular 601-I, free from U.S. Geological Survey, National Center, Reston, Virginia 22092

"Don't Leave It All To The Experts, The Citizen's Role in Environmental Decision Making," U.S. E.P.A., Office of Public Affairs, USGPO. $0.55.

"Community Action for Environmental Quality." Prepared by the Citizen's Advisory Committee on Environmental Quality, GPO, Washington, D.C. 20402 $0.60.

"Watersheds for Water Management." Extension Bulletin 364, Michigan State University, Cooperative Extension Service, E. Lansing.

"A Primer on Water Quality." Swenson and Baldwin, U.S. Geological Survey. $0.30.

"A Primer on Ground Water." Baldwin and McGuiness, U.S. Geological Survey. $0.25.

"A Primer on Water." Leopold and Langbein, U.S. Geological Survey. $0.35.

"A Primer on Waste Water Treatment." Federal Water Quality Administration. $0.55.

Public Agencies / Public Acts

local government

Local units of government in most states have been granted powers to protect and regulate the local environment. Such powers cannot conflict with state laws on the subject and in some cases the state may have completely preempted the field (for example, minimum water quality standards). There are usually many options still open however, and local units can establish meaningful controls over or otherwise guide the protection of the local environment, especially creeks.

You should become familiar with the responsibilities and capabilities of county and municipal agencies in your community. County agencies which can help are: the Planning Commission; Departments of Public Works and of Public Health; Drain Commission; and Parks and Recreation Commission. Municipal and Township government officials and agencies are also very important. Other key officials are the zoning administrator, building inspector, attorney, and assessor.

Special purpose agencies and regional or watershed organizations can provide creek management services, sanitary districts, watershed councils, councils of governments, regional planning commissions, soil conservation districts, and special drainage districts.

state government

The State of Michigan has many Public Acts which relate to creek management. The Acts most directly related to creek or water resource management, and the agency administering each include:

Public Act	Administering Agency
Dam Act 156 of 1851	Hydrology Division, Michigan Department of Natural Resources, Mason Bldg, Lansing 48926
Dam Act 184 of 1963	Same as above
Drain Code, PA 40 of 1956	County Drain Commission
Inland Lakes and Streams Act, PA 346 of 1972	Submerged Lands Division, Department of Natural Resources
Water Resources Commission Act, PA 245 of 1929	Water Resources Commission, Department of Natural Resources
Natural Rivers Act, PA 231 of 1970	Office of Planning Services, Department of Natural Resources
Soil Erosion & Sedimentation Control Act, PA 347 of 1970	Local County Enforcing Agency or Water Development Services Division, Department of Natural Resources
Open Space and Farmland Preservation Act, PA 116 of 1974	Office of Land Use, Department of Natural Resources
County Health Act, PA 306 of 1927	County Health Department
Subdivision Control Act, PA 288 of 1967	Many county agencies: Road Commission, Drain Commission, Health Dept., Planning Commission

Copies of the Acts can be obtained from your State Representative or Senator or the Attorney General's Office.

Other Michigan agencies which may be involved are:
Michigan Department of Agriculture, (Inter-County Drain Commission, Soil Conservation Committee); Lewis Cass Building, Lansing, Michigan 48913.

Michigan Department of State Highways; State Highways Building, Lansing, Michigan 48926.

federal government

Federal legislation related to creek protection and management deals more with general water pollution control and abatement, and is administered by either the Federal Environmental Protection Agency and/or the several states. Copies of these laws and information about who administers them in your area can usually be obtained from your U.S. Congressman or Senator.

The National Environmental Policy Act of 1970 Public Law 91-190

This is the law requiring the preparation and review of an Environmental Impact Statement on all projects undertaken with Federal financial assistance that would have an effect on the environment.

The Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500

The National Pollution Discharge Elimination System (which is being administered in Michigan by the State Department of Natural Resources) requires that the public be given the opportunity to comment on pollution discharge permit applications. Such discharges could be to creeks or streams.

The Federal Flood Disaster Protection Act of 1973, Public Law 93-254

The intent of this legislation is to keep additional development out of flood hazard areas which would include creeks and tributary streams in urbanized areas.

Watershed Protection and Flood Prevention Act Public Law 83-566

Financial and technical assistance emphasizing physical changes to a stream is focused on small watersheds. If a thorough analysis of all creekshed conditions indicates that action is required which can be undertaken under the Public Law 83-566 program without endangering other creek benefits, discussions should then occur with the appropriate state or regional office of the Soil Conservation Service.

REFERENCES

Alternatives to Urban Sprawl: Legal Guidelines for Governmental Action, Fred P. Bosselman, National Commission on Urban Problems Research Report No. 15, for sale by U.S. Government Printing office, Wash., D.C. 20402, 1968, 69 pp. $0.70.

Analysis of Urban Land Treatment Measures for Flood Peak Reduction, Alan M. Lumb, et al., Environmental Resources Center, Georgia Institute of Technology, Atlanta, Georgia 30332, ERC-0574, June 1974, 146 pp.

Approaches to Stormwater Management, B.C. Becker et al., Hittman Associates, Inc., distributed by National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22151, (PB 228-124), November 1973, 258 pp.

The Brandywine: Five Years After, Judith Benedict and Cheryl Wasserman, Institute for Environmental Studies, University of Pennsylvania, Philadelphia, Pa. 19104, February 1972, 102 pp.

Community Action Guidebook for Soil Erosion and Sedimentation Control, Mel D. Powell, et al., National Association of Counties Research Foundation, 1001 Connecticut Ave., N. W., Wash. D.C. 20036, March 1970, 64 pp.

Conservation and Flooding Easements: A Case Study. Sondra K. Slade, Institute for Environmental Studies, University of Pennsylvania, Philadelphia, Pa. 19104, December 1970, 21 pp. plus Notes and Appendices.

Drainage Basin Form & Process, A geomorphological Approach, K.J. Gregory and D. E. Walling, John Wiley and Sons, New York, 1973, 456 pp. $18.95.

Effects of Land Use on Municipal Watersheds, T. Ewald Maki and William L. Hafley, Report No. 71, Water Resources Research Institute, North Carolina State University, 124 Riddick Bldg., Raleigh, N.C. 27607, July 1972, 224 pp. $2.50.

Effects of Watershed Changes on Streamflow, Walter L. Moore and Carl L. Morgan eds., University of Texas Press, Austin, Texas, 1969, 289 pp., $12.50.

Guidelines for Erosion and Sediment Control Planning and Implementation, U.S. Environmental Protection Agency Report #EPA-R2-72-015, for sale by U.S. Government Printing office, Wash. D.C. 20402, August 1972, 228 pp., $1.75.

Landscape Compartmentalization: An Ecological Approach to Land Use Planning, James E. Wuenscher and James M. Starrett, Water Resources Research Institute, University of North Carolina, Report No. 89, December 1973, 107 pp.

Management of Storm Water Runoff in Suburban Environments, Gary D. Beers, Engineering Science Inc., distributed by National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22151, (PB 228-010), November 1973, $4.50.

Planning and Design Workbook for Community Participation: An Evaluation Survey, Lance Jay Brown and Dorothy E. Whiteman, School of Architecture and Urban Planning, Princeton University, Princeton, J.J. 08540, 1973, 51 pp.

The Politics of Development Review in the Lake Tahoe Basin, William E. Felts and Geoffrey Wandesforde-Smith, Institute of Governmental Affairs, University of California, Davis, Ca. 95616, Env. Quality Series #16, May 1973, 40 pp.

Practices in Detention of Stormwater Runoff: An Investigation of Concepts, Techniques, Applications, Costs, Problems, Legislation, Legal Aspects and Opinions, Herbert G. Poertner, American Public Works Association, 1313 E. 60th Street, Chicago, Ill. 60637, Special Report No. 43, 1974, 231 pp. $12.50.

Promoting Environmental Quality Through Urban Planning & Controls, Edward J. Kaiser, et al., U.S. Environmental Protection Agency, Report No. EPA 600/5-73-015, for sale by U.S. Government Printing Office, Wash. D.C. 20402, February 1974, 441 pp., $4.25.

Regulation of Urban Development to Control Runoff and Erosion, Ann L. Strong, Institute for Environmental Studies, University of Pennsylvania, Philadelphia, Pa. 19104, 1972, 26 pp.

The Relationship Between Land Use and Environmental Protection, E. J. Croke, et al., Argonne National Laboratory, Center for Environmental Studies, distributed by National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22151, (PB 209-642), March 1972, 61 pp. $4.50.

Role of Water in Urban Planning and Management, William J. Schnieder et al., U.S. Geological Survey Circular 601-H, U.S. Geological Survey, Wash., D.C. 20242, 1973, 10 pp., free.

Rural Zoning in the United States, Economic Research Service, U.S. Department of Agriculture, Miscellaneous Publication No. 1232, for sale by U.S. Government Printing office, Wash. D.C. 20402, Stock No. 0100-2519, July 1972, 170 pp. $1.50.

Stream Channelization: What Federally Financed Draglines & Bulldozers Do to Our Nation's Streams, Fifth Report by the Committee on Government Operation, 93 Congress First Session House Report No. 93-530, September 27, 1973, 139 pp., (for sale by U.S. Government Printing office, Wash., D.C. 20402, Stock No. 5271-00371, $1.20).

Survey of Economic-Ecologic Impacts of Small Watershed Development, R. M. North, et al., Institute of Natural Resources, University of Georgia, Athens, Ga. 30602, ERC 0974, June 1974, 122 pp.

Toward A Cleaner Aquatic Environment, Kenneth M. Mackenthun, U.S. Environmental Protection Agency, for sale by U.S. Government Printing Office, Stock No. 5501-00573 1973, 273 pp. $2.05 (paper cover).

Water Pollution Aspects of Urban Runoff, Federal Water Pollution Control Administration, U.S. Department of the Interior WP-20-15, for sale by U.S. Government Printing office, Janaury 1969, 272 pp.

"Barrington Area Plans for Controlled Growth", Robert B. Teska, **Planners Notebook** Vol. 3, No. 2, April 1973, American Institute of Planners, 8 pp.

"The Power of Water in Planning," Roger Wells, **Landscape Architecture,** January 1974, pp. 21-26.

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The Department of Natural Resources
Stevens T. Mason Building
Lansing, Michigan 48926

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THE WASHTENAW COUNTY DRAIN COMMISSION

The Washtenaw County Drain Commission is the county agency responsible for the streams and drainage ways. The Commission administers Public Act 40 of 1956, the state "Drain Code", and, under it, has broad responsibility for water resources management in the county. The Drain Code permits the Drain Commissioner to organize, administer, manage, plan and finance work in the county's water courses.

The Drain Commissioner can assist individuals and local governments in conducting creekshed management. Technical services from the Commission can be made available on an ongoing basis. Such assistance can be of benefit in both the short range decisions facing governmental units and also in the long range planning most communities regard as essential.

For further information in Washtenaw County contact:

Jerome K. Fulton, Drain Commissioner, or
Thomas Bletcher, Jr., Deputy Drain Commissioner,
Washtenaw County Drain Commission,
County Building,
Ann Arbor, Michigan 48108, 313-994-2525